Name ______________________ Student Number ______________

All solutions are to be presented on the paper in the space provided. The quiz is open book. You can discuss the problem with others and ask the TA questions.

(1) Find y' when $y^2 + \cos(x^2) = e^{xy}$
Differentiate implicitely:

$$\begin{aligned}
\frac{d}{dx}(y^2 + \cos(x^2)) &= \frac{d}{dx}e^{xy} \\
2yy' - 2x\sin(x^2) &= (y + xy')e^{xy} \\
y'(2y - xe^{xy}) &= 2x\sin(x^2) + ye^{xy} \\
y' &= \frac{2x\sin(x^2) + ye^{xy}}{2y - xe^{xy}}
\end{aligned}$$

(2) Find $f'(x)$ when $f(x) = \sin(|x|)$.
Use the chain rule:

$$\begin{aligned}
f'(x) &= \frac{d}{dx}\sin(|x|) \\
&= \cos(|x|)\frac{d}{dx}|x| \\
&= \cos(|x|)\begin{cases} 1, & x > 0 \\ -1, & x < 0 \end{cases} \\
&= \begin{cases} \cos(x), & x > 0 \\ -\cos(x), & x < 0 \end{cases}
\end{aligned}$$

Note that $f(x)$ is *not* differentiable at $x = 0$ since $|x|$ is not differentiable at $x = 0$.

Over→

(3) Calculate $\dfrac{d}{dx}\left(\sqrt[4]{\tan^{-1}(x^2-1)}\right)=$

$$\frac{1}{4}\left(\tan^{-1}(\sqrt{x^2-1})\right)^{-\frac{3}{4}}\frac{d}{dx}\tan^{-1}(x^2-1)$$
$$=\frac{1}{4}\left(\tan^{-1}(\sqrt{x^2-1})\right)\frac{1}{1+(x^2-1)^2}2x$$

Do not simplify any further than this.

(4) Calculate the derivative of

$$y=\frac{(x^2+1)(x-\sin(x))^2}{2^x\sqrt{x}}$$

Use logarithmic differentiation:

$$\ln y=\ln\left(\frac{(x^2+1)(x-\sin(x))^2}{2^x\sqrt{x}}\right)$$
$$=\ln(x^2+1)+\ln(x-\sin x)^2-\ln 2^x-\ln\sqrt{x}$$
$$=\ln(x^2+1)+2\ln(x-\sin x)-x\ln 2-\frac{1}{2}\ln x$$

Differentiate both sides implicitely

$$\frac{y'}{y}=\frac{1}{x^2+1}2x+2\frac{1}{x-\sin x}(1-\cos x)-\ln 2-\frac{1}{2x}$$

If you did this without log. diff. then you did too much work and won't get full marks for the question.